



DOER Green Communities  
Webinar

September 11, 2013

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COMMONWEALTH OF MASSACHUSETTS

Deval L. Patrick, Governor  
Richard K. Sullivan, Jr., Secretary  
Mark Sylvia, Commissioner

## LED Streetlights

### What Is Your Plan?

**Aimee Powelka**  
Municipal Efficiency Coordinator  
Green Communities Division, DOER

**Edward Bartholomew**  
Commercial Lighting Program Manager  
National Grid

## Green Communities Division

Serves as the hub for all Massachusetts cities and towns on energy matters



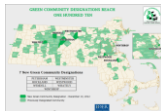
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## Green Communities Division Programs & Resources for Municipalities

- Green Communities Designation and Grant Program
- MassEnergyInsight energy tracking tool
- Municipal Energy Efficiency Program
- Renewable Energy and Alternative Transportation
- Performance Contracting Technical Assistance (EMS)
- Website filled with tools & resources - [www.mass.gov/doer](http://www.mass.gov/doer)
- Email updates via listserv – Sign up by sending an email to: [join-ene-greencommunities@listserv.state.ma.us](mailto:join-ene-greencommunities@listserv.state.ma.us)



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## Outreach - Regional Coordinators

- Regional Coordinators act as direct liaisons with cities and towns on energy efficiency and renewable energy activities
- Located at each of the DEP Regional Offices:



SERO – LAKEVILLE: Seth Pickering  
[Seth.Pickering@state.ma.us](mailto:Seth.Pickering@state.ma.us)

NERO – WILMINGTON: Joanne Bissetta  
[Joanne.Bissetta@state.ma.us](mailto:Joanne.Bissetta@state.ma.us)

CERO – WORCESTER: Kelly Brown  
[Kelly.Brown@state.ma.us](mailto:Kelly.Brown@state.ma.us)

WERO – SPRINGFIELD: Jim Barry  
[Jim.Barry@state.ma.us](mailto:Jim.Barry@state.ma.us)



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## Recording & Presentation

- The webinar is being recorded and will be available on our website in approximately 48 hours at:  
[www.mass.gov/energy/greencommunities](http://www.mass.gov/energy/greencommunities)
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## LED Streetlights

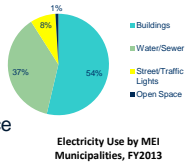
Background

**Aimee Powelka**  
Municipal Efficiency Coordinator  
Green Communities Division, DOER

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## Streetlights

- Purpose
  - Accident prevention
    - Reduce pedestrian crashes and fatalities
    - Illuminate intersections and/or hazards
  - Decorative
  - Deter crime
- Consequences
  - Light pollution
  - Cost for energy and maintenance
  - Use energy – emit pollutants
  - Loss of night vision



Electricity Use by MEI Municipalities, FY2013



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## Advantages of LED Streetlights

- Improved safety through enhanced visibility
- Decreased energy consumption
- Visible commitment to efficiency
- Reduced maintenance costs due to longer life
- Decreased light trespass and pollution
- Instant-on
- An opportunity for programmable controls



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## Poll Question #1

- Does your community have any LED streetlights?
  - Yes, in many places
  - Yes, a few or a pilot
  - Working on a large-scale retrofit
  - No
  - Unsure



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## Understanding-LED Street Lighting



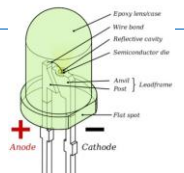
Best LED  
Sentry Equipment-Oconomowoc, Wisconsin

Presenter-  
Edward Bartholomew, LC, IES, LEED AP  
Commercial Lighting | Program Manager

## Solid State Lighting –LED's

Light-Emitting Diodes (LEDs) are solid-state electronic devices that generate light via the transformation of electric energy to radiant energy within the crystalline structure of a semiconductor chip.

- No heated filaments or gases
- Can be reliable, durable, efficacious, long-life, flexible, and very efficient with improved heat sinking and proper care
- Optically effective for direct illumination without much light loss.
- White LED's have a chromaticity closest to natural daylight
- Performance of LED's decreases with increasing temperature

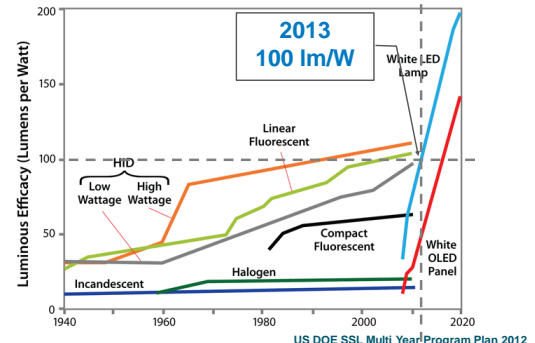


Characteristics Effecting LED Performance

| Light Output               | Junction Temp. Tj | Efficacy | Lifetime | Cost (\$/watt)    | CCT           |
|----------------------------|-------------------|----------|----------|-------------------|---------------|
| Increase LED Input Current | Higher            | Higher   | Worse    | Shorter           | Lower         |
| Decrease LED Input Current | Lower             | Cooler   | Better   | Longer            | Higher        |
| Improve Heat Sinking       | Higher            | Cooler   | Better   | Longer            | Smaller shift |
|                            |                   |          |          | Depends on design | Smaller shift |

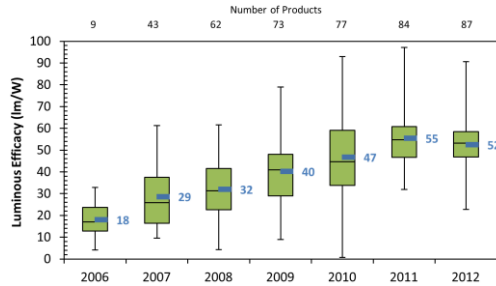
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## Advancement of LED's



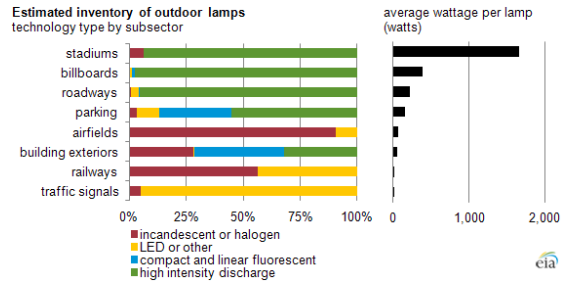
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## Today's LED Efficacy Trends



CALIPER Year in Review 2012

## LED Quality Characteristics



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## Lamp Comparison

|                                    | HPS     | MH      | LED     |
|------------------------------------|---------|---------|---------|
| Luminaire (system) watts           | 183W    | 208W    | 153W    |
| CCT                                | 2000 K  | 4000 K  | 6000 K  |
| CRI                                | 22      | 65      | 75      |
| Rated lamps lumens, initial        | 16000   | 11700   | n/a     |
| Downward luminaire efficiency      | 70%     | 81%     | n/a     |
| Downward luminaire lumens, initial | 11,200  | 9,477   | 10,200  |
| Luminaire efficacy                 | 61 lm/W | 46 lm/W | 67 lm/W |

Sources: HPS and MH: published luminaire photometric (.ies) files. LED: manufacturer data. 2008

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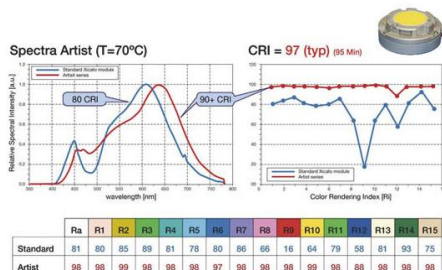
## Lamp Comparison

|                                     | Existing<br>70W HPS | LED<br>3-array        | Optional<br>LED2-array |
|-------------------------------------|---------------------|-----------------------|------------------------|
| Total power draw                    | 97W                 | 72W                   | 48W                    |
| Average illuminance                 | 3.54 fc             | 3.63 fc               | 2.42 fc                |
| Maximum illuminance                 | 7.55 fc             | 5.09 fc               | 3.40 fc                |
| Minimum illuminance*                | 1.25 fc             | 1.90 fc               | 1.27 fc**              |
| Max/Min Ratio (uniformity)          | 6.04:1              | 2.68:1                | 2.68:1                 |
| Energy consumption per luminaire*** | 425 kWh/yr          | 311 kWh/yr            | 210 kWh/yr             |
| Energy savings per luminaire        | --                  | 114 kWh/yr<br>(26.8%) | 215 kWh/yr<br>(50.6%)  |

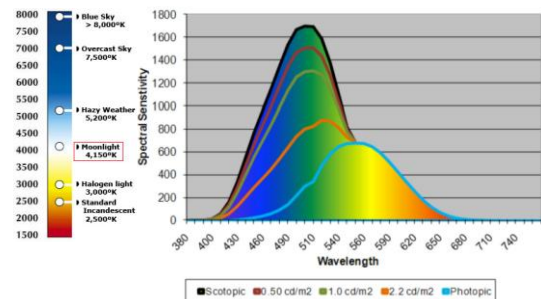
Sources: DOE -Comparison of HPS and LED Outdoor Luminaires for Demonstration Site -2008

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## LED's &amp; Color Rendering Index -CRI



## Broad-Spectrum (White LED) Outdoor Lighting



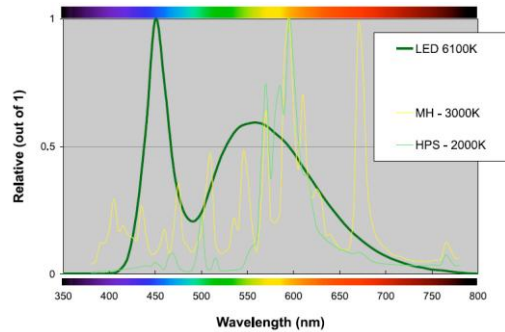
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## Broad-Spectrum (White LED) Outdoor Lighting

- White LEDs with Broad-spectrums including short-wavelength “blue” light are more efficacious than limited spectrum light (i.e. HPS) it is possible to reduce photopic light levels (and wattages).
- Broad-spectrum light sources contribute to better visual performance:
  - Improves small target detection and detection distance
  - provides improved color contrast for visual recognition
  - accommodates the adaptive shift from photopic (cone) vision toward scotopic (rod) vision.
  - Increases peripheral rod based, non-fovea object and motion detection

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## Spectral Power Distribution -SPD

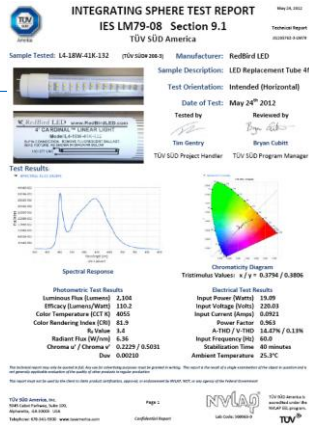


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## LM-79

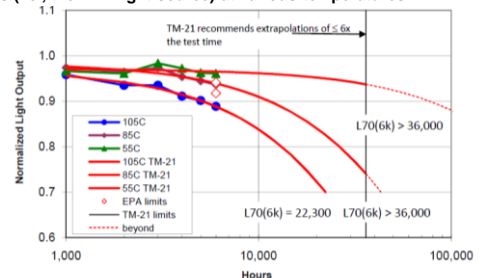
LM-79 is an approved method for taking electrical and photometric measurements of SSL products.

- Total flux (light output)
- Electrical power
- Efficacy
- Chromaticity
- Intensity distribution



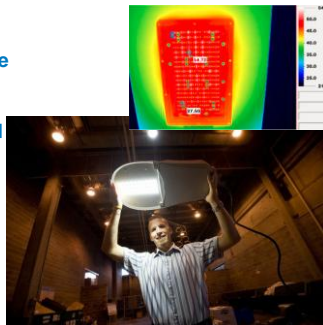
## LM-80

LM-80 is an approved method for measuring the lumen maintenance (L70), of LED packages arrays, and modules, lamps (i.e., the LED light source) at various temperatures.



## In-situ Testing

In-situ testing exceeds LM-79 to provide a more accurate estimate of actual operating temperature in installed conditions. Especially as this relates to thermal performance.



## Street Lighting and Adaptive Controls

Goal: Increase Energy Savings

Strategy: “Smart” Control System Remote/Programmable Dimming

- Lighting based on activity level
- Reduce energy use
- Minimize light pollution
- Consumption Data thru Metering
- Pay for actual energy consumed

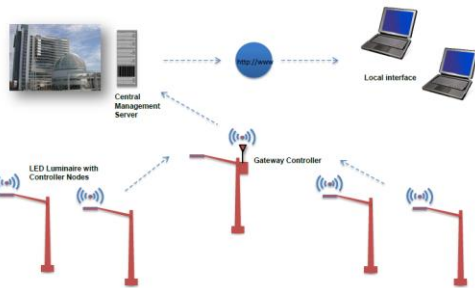


Key findings from the [report \(PDF\)](#), *Lighting the Clean Revolution: The Rise of LED Street Lighting and What it Means for Cities*, include:

- LEDs achieve the expected 50 to 70% energy savings, and reach up to 80% savings when coupled with smart controls. [Energy savings in the trials vary from 18% to 85%, with 20 out of 27 products achieving savings of 50% or more, and ten showing savings of 70% or more.]

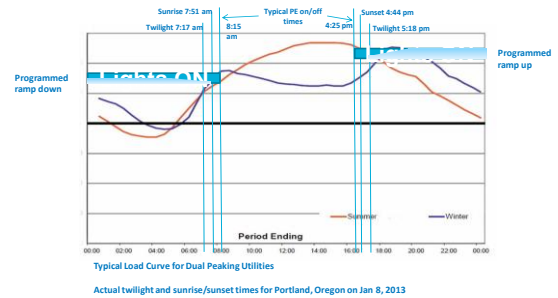
The Climate Group, June 2012  
[www.cleanrevolution.org](http://www.cleanrevolution.org)

## Adaptive –Network Controls



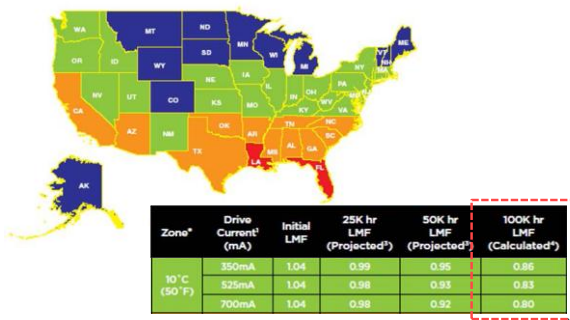
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## Overlap of Lighting and Load



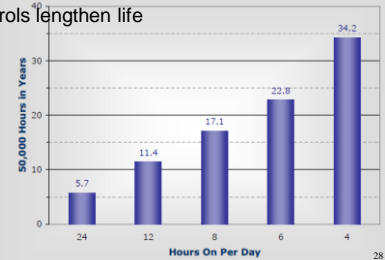
Source: "What a Clean Energy Future Looks Like – An Absolute Nightmare", PA Pandits International March 2011

## Lumen Maintenance Factor –LMF for MA.



## Street Lighting -LED Lamp Life

- LED typically 50,000 hrs life
- Cleaning must be a part of maintenance
- Adaptive controls lengthen life



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## Los Angeles Crime Statistics

## Pre &amp; Post LED Street Lighting (2009-2012)

| Crime Types            | 2009          | 2012          | Percentage Change |
|------------------------|---------------|---------------|-------------------|
| Vehicle Theft          | 15,778        | 13,632        | -13.60%           |
| Burglary-Robbery-Theft | 19,967        | 18,406        | -7.82%            |
| Vandalism              | 11,115        | 9,906         | -10.90%           |
| <b>TOTAL</b>           | <b>46,869</b> | <b>41,944</b> | <b>-10.50%</b>    |

Incidents between hours of 7pm to 7am

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## 2012 Next Generation LED Luminaire Competition



## 2012 Next Generation –Exterior Award Winner Best in Class –Roadway Lighting

Light Output: **6289.4 lumens**  
Input Power: **80.3 watts**  
Efficacy: **78.3 lm/W**  
Power Factor: **100%**  
CCT: **3900K**, CRI: **72**



GE Lighting -The Evolve™ LED Scalable Cobrahead, with its unique, advanced optical design using reflective technology, offers hundreds of photometric combinations.

## Understanding- LED Street Lighting



Presenter-  
Edward Bartholomew, LC, IES, LEED AP  
Commercial Lighting | Program Manager

### Poll Question #2

- What do you consider the most important benefit of LED streetlights?
  - Reduced costs
  - Decreased energy use
  - Improved safety
  - Darkened sky



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## LED Streetlights

*How to Move Forward*

**Aimee Powelka**  
Municipal Efficiency Coordinator  
Green Communities Division, DOER

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## Efficiency Vermont: Improving Efficiency in Municipal Street and Public Space Lighting

1. Form a Team
2. Conduct a Needs Assessment
3. Prepare a Street Lighting Inventory
4. Determine Ownership of Light Fixtures
5. Identify and Eliminate Unnecessary Lighting Fixtures
6. Consider LED Replacement Lighting
7. Determine How New LED Fixtures Will Be Controlled
8. Prepare a Final Project Scope and Budget
9. Build Support
10. Secure Funding
11. Implement Project



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## Streetlight Ownership

Can You Install LED Streetlights Today?

| Ownership and Tariffs | Metered | Unmetered |
|-----------------------|---------|-----------|
| Municipally-Owned     | yes     | yes       |
| Utility-Owned         | no      | no        |



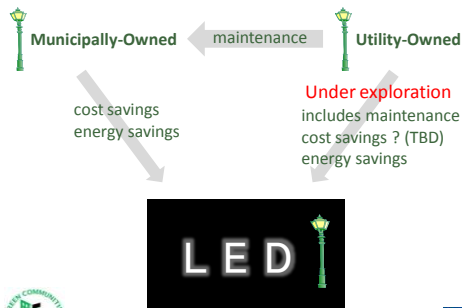
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## Ownership Pathways to LED Streetlights



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## Municipal Tasks to LED Streetlights

|                               |  |
|-------------------------------|--|
| <b>Public Relations</b>       | <ul style="list-style-type: none"> <li>Streetlights are highly visible and can spark public debate</li> </ul>  |
| <b>Lighting Standards</b>     | <ul style="list-style-type: none"> <li>Hire an expert to determine how much light is needed</li> <li>LEDs seem brighter due to their cooler color temperature</li> <li>Light level impacts cost of fixture</li> </ul>        |
| <b>Procurement &amp; Cost</b> | <ul style="list-style-type: none"> <li>State Contract: Comm-Pass FAC76 Category 6</li> <li>MAPC joint procurement</li> <li>Include pre-install activities in scope</li> </ul>  |
| <b>Financing</b>              | <ul style="list-style-type: none"> <li>25A Energy Management Services available for performance contracting</li> </ul>   |
| <b>Incentives</b>             | <ul style="list-style-type: none"> <li>Mass Save incentives available</li> <li>Must contact electric utility PRIOR to order/install</li> <li>Must be on Design Lighting Consortium qualified product list</li> </ul>         |
| <b>Maintenance</b>            | <ul style="list-style-type: none"> <li>In-house labor for the installation?</li> <li>Combine installation and maintenance contracts or keep separate?</li> <li>Need any changes to existing maintenance contract?</li> </ul> |

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## Perform Streetlighting Design Study

- Obtain electric utility's list and map of streetlights
- Verify streetlight inventory with locations, types and wattage
- Determine if there are locations where streetlight wattage could be reduced (or eliminated)\*
- Have a lighting expert assess proposed streetlight reduction areas to recommend lighting levels with LEDs
- Approve target list with local public safety agency and legal department
- Present list to municipal officials and public for input
- Conduct a trial of the new lighting levels
- Ready for LED lighting



\* Requires safety analysis and public outreach

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## LED Applications

- Traffic lights
- Metered streetlights
- Decorative streetlights
- Parking lot/garage lights
- Exterior building lights
- Unmetered streetlights



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## MA Munis with LED Exterior Lighting

| Green Communities Grants | Type  | Other Known LED Exterior Lighting Projects | Type                                 |
|--------------------------|---|--|--------------------------------------|
| Acton                    | Metered, parking lot & spot lighting                                | Cape Light Compact                         | Unmetered                            |
| Arlington                | 2 unmetered projects: GC plus MAPC group procurement                | Boston                                     | Unmetered plus metered decorative    |
| Easthampton              | Unmetered   | Chelsea                                    | Unmetered via MAPC group procurement |
| Holyoke                  | LED traffic signals (plus parking and streetlights using own funds) | Fitchburg                                  | Metered, decorative                  |
| Lexington                | Induction streetlights  | Natick                                     | Unmetered via MAPC group procurement |
| Melrose                  | Metered, decorative   | UMass Amherst                              | Metered, parking lot                 |
| Salem                    | Metered, decorative   | Woburn                                     | Unmetered via MAPC group procurement |

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## Recording & Presentation

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## General Streetlight Resources

- Efficiency Vermont's Step-by-Step Guide: Improving Efficiency in Municipal Street and Public Space Lighting  
[http://www.efficiencyvermont.com/docs/for\\_my\\_business/lighting\\_programs/EVT\\_MunicipalStreetLightingGuide\\_Rev040111.pdf](http://www.efficiencyvermont.com/docs/for_my_business/lighting_programs/EVT_MunicipalStreetLightingGuide_Rev040111.pdf)
- DOE's Municipal Solid State Lighting Consortium  
<http://www1.eere.energy.gov/buildings/ssl/consortium.html>
- The Clinton Climate Initiative's Street Lighting Retrofit Projects  
[http://www.clintonfoundation.org/files/CCI\\_whitepaper\\_lighting\\_2010.pdf](http://www.clintonfoundation.org/files/CCI_whitepaper_lighting_2010.pdf)
- DOE's Technical Assistance Program's webinars:
  - Overcoming Common Pitfalls: Energy Efficient Lighting Projects. (October 10, 2010) <http://www1.eere.energy.gov/wip/solutioncenter/webcasts/default.html>
  - Exterior Solid State Lighting Solutions for Municipalities (April 19, 2011) <http://tinyurl.com/k2uke3v>



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## Streetlight Procurement Resources

- State Contract
  - [www.comm-pass](http://www.comm-pass.com) FAC76, Section 6
  - Dmitry Nikolayev, [Dmitriy.Nikolayev@state.ma.us](mailto:Dmitriy.Nikolayev@state.ma.us)
- MAPC Joint Procurement
  - Erin Brandt, [EBrandt@mapc.org](mailto:EBrandt@mapc.org)
  - <http://www.mapc.org/led-street-lighting>
- Energy Management Services for Performance Contracts
  - Eileen McHugh, [Eileen.McHugh@state.ma.us](mailto:Eileen.McHugh@state.ma.us)
  - <http://www.mass.gov/eea/energy-utilities-clean-tech/green-communities/ems.html>



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## Compliance with Construction Law

Some purchases of lighting fixtures under this contract fall under the requirements of statutes governing building and public works construction (MGL Chapter 149, and Chapter 30 Section 39M respectively). The following table explains how those statutes apply to the contract, based on the ordering option and project type:

| Project type  | Order / Project Size Limit Under the Contract | Applicable Procurement Law for Projects Above Order / Project Limit |
|---|---|---|
| Fixtures for projects using municipal staff   | No limit                                      | N/A   |
| Fixtures for multiple projects using hired labor (installation procured separately) | No limit                                      | N/A   |
| Fixtures for a single project using hired labor (installation procured separately)  | \$10,000                                      | MGL Chapter 30 Section 39M*   |
| Fixtures and installation procured together   | \$10,000                                      | MGL Chapter 149, or Chapter 30 Section 39M*                         |

\* Eligible Entities are advised to consult the Inspector General's Office for guidance on the application of the construction statutes referenced above.



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## Compliance with Construction Law

- **Definition of "project."** If an Eligible Entity intends to install fixtures in multiple locations, the following guidance will apply:
- If the work is going to be performed in phases and potentially by multiple installers (i.e., when installers are allowed to bid on portions of the work, even if one wins everything), Eligible Entities may consider each phase / portion of the total scope of work to be a separate project. The contract does not impose a limit on the purchase of fixtures for multiple projects, as long as the fixtures do not require to be installed by "manufacturer certified" contractors. Eligible Entities may order all the fixtures at once and stock them, or they may schedule separate deliveries for each project under the same purchase order.
- If the work in all the locations/spaces/buildings is going to be performed at the same time and is expected to be awarded to only one installer, it should be considered one project. The contract limits purchases of fixtures for such single projects with hired labor to \$10,000.



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## Thank You

- Edward Bartholomew
  - Commercial Lighting Program Manager
  - National Grid
  - [Edward.Bartholomew@nationalgrid.com](mailto:Edward.Bartholomew@nationalgrid.com)
- Aimee Powelka
  - Municipal Efficiency Coordinator, Green Communities Division
  - Department of Energy Resources
  - [Aimee.Powelka@state.ma.us](mailto:Aimee.Powelka@state.ma.us)
  - 617-626-7356
- Are You Willing to Share Your Streetlight Project?
  - Please write in your contact info to the webinar or email: [Aimee.Powelka@state.ma.us](mailto:Aimee.Powelka@state.ma.us)

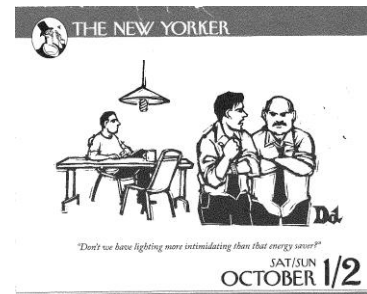


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## Time for Some Tough Questions



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